

1 **WHAT IS CLAIMED IS:**

2 1. A channel noise estimating method applied to a multi-carrier system
3 consisting of K subchannels over which original data symbols ($X_k[n]$) (where n is
4 the discrete time index, $k \in \{1, 2, \dots, K\}$ is the subchannel index) are transmitted in
5 a frequency-domain from a transmitting unit to a receiving unit, the noise
6 estimating method comprising the acts of:

7 reconstructing simulated input data symbols ($X'_k[n]$) that simulate the
8 original data symbols ($X_k[n]$);

9 delaying the actual received data symbols ($R_k[n]$) such that the delayed
10 actual received data symbols ($Q_k[n]$) are synchronous to the simulated input data
11 symbols ($X'_k[n]$);

12 calculating a channel response estimate ($W_k[n]$) of one subchannel k
13 based on said delayed actual received data symbols ($Q_k[n]$) and said simulated
14 input data symbols ($X'_k[n]$) according to the Least Mean Square algorithm;

15 estimating virtual received data symbols ($Y_k[n]$) based on said channel
16 response estimate ($W_k[n]$) and the simulated input data symbol ($X'_k[n]$); and

17 calculating a different quantity ($e_k[n]$) between the delayed actual
18 received data symbol ($Q_k[n]$) and the estimated virtual received data symbols
19 ($Y_k[n]$) to represent the channel noise of said subchannel k .

20 2. The method as claimed in claim 1, in the simulated input data symbols
21 ($X'_k[n]$) reconstructing act, the original data symbols ($X_k[n]$) being taken as the
22 simulated input data symbols ($X'_k[n]$) while the original data symbols ($X_k[n]$) are
23 exactly known to the receiving unit.

24 3. The method as claimed in claim 1, the simulated input data symbols

1 $(X'_k[n])$ reconstructing act further having:
2 de-mapping and decoding the actual received data symbols ($R_k[n]$) on
3 each subchannel k to extract bit-stream data; and
4 encoding and mapping said bit-stream data to reconstruct said simulated
5 input data symbols ($X'_k[n]$).

6 4. The method as claimed in claim 3, wherein the simulated input data
7 symbols ($X'_k[n]$) reconstructing act further has a de-interleaving act after the
8 actual received data symbols ($R_k[n]$) de-mapping act, and an interleaving act
9 after the bit-stream data encoding act.

10 5. The method as claimed in claim 1, in the simulated input data symbols
11 ($X'_k[n]$) reconstructing act, said actual received data symbols ($R[n]$) on the
12 subchannel k being directly mapped to form the simulated input data symbol
13 ($X'_k[n]$) for said subchannel k .

14 6. A channel noise estimating apparatus applied to a multi-carrier system
15 consisting of K subchannels over which original data symbols ($X_k[n]$) (where n is
16 the discrete time index, $k \in \{1, 2, \dots, K\}$ is the subchannel index) are transmitted in
17 a frequency-domain from a transmitting unit to a receiving unit, the noise
18 estimating apparatus comprising:

19 a reconstructing unit for generating simulated input data symbols ($X'_k[n]$)
20 that simulate the original data symbols ($X_k[n]$);

21 a D -tap delay line provided to delay actual received data symbols ($R_k[n]$)
22 that are received by the receiving unit such that the delayed actual received data
23 symbols ($Q_k[n]$) are synchronous to the simulated input data symbols ($X'_k[n]$),
24 wherein D is an integer greater than or equal to zero;

1 a channel response estimating unit, which estimates a channel response
2 estimate ($W_k[n]$) of one subchannel k based on said delayed actual received data
3 symbols ($Q_k[n]$) and said simulated input data symbols ($X'_k[n]$) according to the
4 Least Mean Square algorithm;

5 a channel noise calculating unit corresponding to said channel response
6 estimating unit, where the channel noise calculating unit estimates virtual
7 received data symbols ($Y_k[n]$) based on said channel response estimate ($W_k[n]$)
8 and the simulated input data symbol ($X'_k[n]$);

9 wherein the channel noise calculating unit further calculates a different
10 quantity ($e_k[n]$) between the delayed actual received data symbol ($Q_k[n]$) and the
11 estimated virtual received data symbols ($Y_k[n]$) to represent the channel noise of
12 said subchannel k .

13 7. The apparatus as claimed in claim 6, wherein while the original data
14 symbols ($X_k[n]$) are exactly known to the receiving unit, the reconstructing unit
15 takes the original data symbols ($X_k[n]$) as the simulated input data symbols
16 ($X'_k[n]$), and the actual received data symbols are directly passed through the
17 delay line without a delaying process.

18 8. The apparatus as claimed in claim 6, wherein the reconstructing unit
19 based on the actual received data symbols $R_k[n]$ on each subchannel k generates
20 simulated input data symbols ($X'_k[n]$).

21 9. The apparatus as claimed in claim 8, the reconstructing unit having:
22 a bit-stream data extractor, which de-maps and decodes the actual
23 received data symbols $R_k[n]$ on each subchannel k to construct the bit-stream
24 data of the actual received data symbol; and

1 a constructor, which encodes, and maps said bit stream data to
2 reconstruct said simulated input data symbols ($X'_k[n]$) for each subchannel k .

3 10. The apparatus as claimed in claim 9, said bit-stream data extractor
4 further including a de-interleaver, and said constructor further including an
5 interleaver.

6 11. The apparatus as claimed in claim 8, wherein the reconstructing unit
7 directly maps said actual received data symbols ($R_k[n]$) on the subchannel k to
8 form the simulated input data symbol ($X'_k[n]$) for said subchannel k .